Claims

1.   A spectroscopic system for measuring thickness of a material, wherein the system comprises:

a) a tunable light source, wherein the source provides a beam of light incident to the material; and,

b) a first detector that detects light from the light source either reflected from or transmitted through the material; and,

c) a computing device that computes the material thickness based on data received from the detector.

2.   The spectroscopic system according to claim 1, wherein the light source is a quasi-monochromatic light source.

3.   The spectroscopic system according to claim 1, wherein the first detector is a photodiode sensor.

4.   The spectroscopic system according to claim 1, wherein the tunable light source provides wavelengths of light varied in increments less than 0.1 nm.

5.   The spectroscopic system according to claim 1, wherein the first detector detects light reflected from the material.

6.   The spectroscopic system according to claim 1, wherein the first detector

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detects light transmitted through the material.

7.   The spectroscopic system according to claim 1, wherein the light source provides a beam of light to the material, and wherein the incident light angle is less than ± 5° from normal.

8.   The spectroscopic system according to claim 1, wherein the system further comprises:

a splitter, wherein the splitter splits the beam of light from the wavelength source into a measurement light path and a reference light path, and wherein the measurement light path is directed to the material, and wherein the reference light path is used to calibrate light wavelength.

9.   The spectroscopic system according to claim 8, wherein the system further comprises:

a first collimating lens, and wherein the first collimating lens focuses light from the measurement light path onto a partially transmitting beamsplitter, and wherein the beamsplitter directs a portion of the light onto the material.

10.   The spectroscopic system according to claim 9, wherein the system further comprises:

a defocusing lens, and wherein the defocusing lens reduces the area of light reflected from the sample which reaches the detector.

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11.   The spectroscopic system according to claim 10, wherein the system further comprises:

a first electrical amplifier, wherein the first electrical amplifier converts output from the detector into voltage.

12.   The spectroscopic system according to claim 11, wherein the system further comprises:

a first analog to digital converter, and wherein the first analog to digital converter provides output to a data acquisition system within the computing device.

13.   The spectroscopic system according to claim 12, wherein the system further comprises:

a second collimating lens, and wherein the second collimating lens focuses light from the reference light path onto an etalon, and wherein light transmitted through the etalon is used to calibrate light wavelength.

14.   The spectroscopic system according to claim 13, wherein the system further comprises:

a second detector, wherein the second detector is a photosensitive detector, and wherein the second detector detects light transmitted through the etalon, and wherein the second detector produces a current output, and wherein the current output is used to calibrate light wavelength.

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15. The spectroscopic system according to claim 13, wherein the system further comprises:

a second electrical amplifier, and wherein the second electrical amplifier converts current output from the second detector into voltage, and wherein the voltage is transformed from analog to digital data by means of a second analog to digital converter, and wherein the digital data is transferred to the computing device where it is used to calibrate light wavelength.

16. A method of measuring material thickness, wherein the method comprises:

a) loading the material to be measured into a holder of a spectroscopic system, wherein the system comprises a tunable light source which provides a beam of light incident to the material, a detector which detects light from the light source either reflected from or transmitted through the material, and a computing device that computes the material thickness based on data received from the detector;

b) measuring the light reflected from or transmitted through the material at at least two different wavelengths using the detector; and,

c) computing material thickness using a computing device based on data received from the detector.

17. The method according to claim 16, wherein the tunable light source is a quasi-monochromatic light source.

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18. The method according to claim 16, wherein the detector is a photodiode sensor.

19. The method according to claim 16, wherein the two different wavelengths vary by about 0.1 nm.

20. The method according to claim 16, wherein the method is used to measure material thickness in the range of 1 μm to 1000 μm.

21. The method according to claim 16, wherein the method provides a repeatability of thickness measurement of less than 1%.

22. The method according to claim 16, wherein the beam of light illuminates a roughly spherical area less than 200 μm in diameter on the material.

23. The method according to claim 16, wherein the light reflected from or transmitted through the material is measured at at least 10 different wavelengths, and wherein the ten different wavelengths vary incrementally in increments of about 0.1 nm.

24. The method according to claim 23, wherein computing the material thickness comprises:

a) measuring sample reflectivity or transmission and etalon transmission at a fixed wavelength point;

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b) varying the wavelength at which measurements of reflectivity or transmission are measured by changing tuning voltage of the wavelength source;

c) repeating steps "a" and "b" over a number of points to provide a number of sample signals and etalon signals;

d) using data obtained from the sample signals and etalon signals to calculate material thickness.

25. The method according to claim 24, wherein computing the material thickness further comprises:

a) measuring and saving values for a reference;

b) using the reference values to convert sample signals to reflectivity values; and,

c) using the reflectivity values to calculate material thickness.

26. The method according to claim 25, wherein computing the material thickness further comprises:

a) computing a theoretical model of sample reflectivity, wherein the model includes values; and,

b) varying the value of sample thickness until a best fit occurs between theoretical sample reflectivity values and measured sample reflectivity values,

which provides a material thickness.

27. The method according to claim 26, wherein a curve-fitting technique is

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used to fit the theoretical model of sample reflectivity and measured reflectivity values.

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